

Role of Cardiotocography in predicting perinatal outcome in high-risk pregnancy

Cardiotocography in high risk pregnancy

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Abstract

Aim: In this study, it was aimed to evaluate the efficacy of fetal cardiotocography in predicting perinatal outcome.

Materials and method: In this retrospective observational study, 400 gravid women with high-risk pregnancy fulfilling the eligibility criteria were enrolled. The results of C TG were studied according to NICE 2017 guidelines. Perinatal outcomes were studied by the color of liquor, Apgar score at one minute and five minutes, and NICU admission. Statistical analysis was done using a t-test and p-value <0.05 was considered statistically significant.

Results: PIH was the most common risk factor in 32 % of females. C TG was reactive in 163(40.7%) patients and nonreactive (suspicious and pathological) in 237(59.2%) patients. One hundred thirty (54%) females with nonreactive C TG had meconium-stained liquor compared to only 18(11%) in the reactive group (p-value <0.05). In the reactive group, only 4% of babies had Apgar 5min <7 compared to 32.4% in the non-reactive group. Perinatal morbidity in the form of NICU admission was higher in the non-reactive group in 77 (32.4%) patients compared to 7 (4%) patients in the reactive group. The sensitivity and specificity of C TG for predicting neonatal morbidity were 63% and 80.4%, while its PPV and NPV were 49.4% and 89.4%, respectively.

Discussion: C TG has shown high specificity and negative predictive value for detecting adverse perinatal outcomes in this study. This appears to be a simple, non-invasive test that can serve as a screening tool to detect fetal distress that is already present or likely to develop during labor in high-risk obstetric patients in centers with a heavy workload.

Keywords

Cardiotocography; Perinatal outcome; Apgar score

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Introduction

Fetal surveillance during labor is necessary to ensure a safe passage of the fetus from an intrauterine to an extrauterine environment with minimum interventions. Birth asphyxia is a broad term that refers to intrapartum asphyxia sufficient to cause neurological damage in some newborns, and rarely intrapartum or neonatal death. The mechanism of labor itself presents as physiological stress to the fetus. Several intrapartum events, such as cord compression, fetoplacental blood flow compromise, may cause hypoxia and metabolic acidosis and has the potential to cause neurological injury [1]. Thus, intrapartum FHR monitoring is of paramount importance. FHR monitoring can be done either by intermittent auscultation or electronic fetal monitoring. Like intermittent auscultation, continuous electronic fetal monitoring was introduced clinically in the labor wards in the 1950s with the emphasis on improving fetal birth outcomes by detecting fetal hypoxia, before it leads to death or disability [2]. Intermittent auscultation can measure the baseline FHR but other features such as beat-to-beat variability, accelerations and decelerations in response to uterine contraction remain unappreciated, which is possible only with CTG, thus CTG played the role [3].

FHR has 4 features shown in Table 1 based on NICE 2017 guidelines, and different features of CTG reflect fetal health status. These guidelines are descriptive in character and categorize CTG as normal, suspicious, and pathological. Abnormality of the CTG, sometimes severe enough to be described as pathological trace, is commonly termed fetal distress, will require immediate delivery, whereas suspicious pattern prompts to expedite the process of delivery. Considering the wider clinical picture in interpreting the CTG, and taking timely and appropriate action based on the findings, may help prevent birth asphyxia.

The main justification for CTG is that the uterine contraction during labor decreases the placental circulation, and this is aggravated if chronic placental insufficiency is present since the antenatal period. An abnormal tracing identifies a deficiency and hence recognizes fetal compromise at an early stage to allow timely intervention. However, it is not rarely for records to be false positive or false negative. False-positive means that the record is pathological and fresh, undepressed child is born without acidosis; false-negative record means that with the normal CTG record, asphyxiated/depressed child is born and that later will manifest itself in neurodevelopmental disorders [4]. Although the 2017 NICE guidelines do not recommend continuous CTG in low-risk women, risk factors can arise during labor, and therefore CTG is required to detect any changes reflecting fetal hypoxia. Thus, the aim of this study is to evaluate the predictive value of CTG in detecting fetal hypoxia during labor and to correlate the results of the CTG with perinatal outcome in high-risk obstetric cases.

Material and Methods

This retrospective study was conducted at the Department of Obstetrics and Gynecology, AIIMS Patna from January 2015 to December 2018. After obtaining the institutional ethical committee approval, the study was started. A total of 400 high-risk antenatal mothers who met the inclusion criteria

were analyzed. Period of gestation was ascertained using a first-trimester scan or a reliable menstrual history if an early scan was not available. All the demographic and medical data were obtained from the history sheet and the CTG trace was categorized according to the 2017 NICE guideline as normal, suspicious, and pathological. Neonatal data obtained from the baby sheet and its outcome was predicted according to staining of meconium, APGAR at 1 and 5 minutes, and NICU admission. Inclusion criteria were singleton pregnancy, >37 weeks of pregnancy, first and second stage of labor, cephalic presentation, onset of labor (either spontaneous or induced), high-risk factors (postdatism, PIH, GDM, oligohydramnios, polyhydramnios, IHCP, anemia and previous LSCS).

Exclusion criteria were POG <37 weeks, USG-confirmed severe congenital anomaly, acute hypoxic states such as abruptio placentae, abnormal lie and presentation.

Interpretation of fetal heart rate pattern

- Baseline fetal heart rate-110-160 bpm.
- Tachycardia-sustained rise in FHR > 160 bpm for >10 min.
- Bradycardia-sustained fall in FHR < 110 bpm for >10 min.
- Baseline variability is the difference between two lines drawn through the highest and lowest points of the trace in any 1-min segment. Normal value is 5-25 bpm.
- Accelerations- Rise in FHR > 15 bpm above baseline for >15 s.
- Decelerations- Fall of FHR > 15 bpm below the baseline, lasting >15 s.
- Early decelerations- FHR falls to no more than 15 beats below the baseline, and the lowest point of fetal heart rate occurs within 20 s of uterine contraction.
- Late deceleration- Deceleration where the lowest part of fetal heart rate occurs after the peak of the uterine contraction, and that occurs in more than 50% of the 20-minute trace.
- Variable deceleration- All decelerations which do not have any correlation with uterine contraction.
- Prolonged deceleration- deceleration lasting > 3 minutes.

Statistical Analysis

The data were analyzed using SPSS version 26. Groups were compared using the t-test. A p-value <0.05 was considered statistically significant.

Results

Four hundred gravid women were included in the study. Most of the patients (91%) were in the 20-30 years age group, 39% were primi and 61% were multigravida, 86% delivered at term and 14% were at post-term gestation. The commonest risk factor was PIH (32%) followed by IHCP (23%), GDM (18%) and postdatism (14%); 86% of them had one risk factor whereas 14% of women had multiple risk factors. Table 1 summarizes the maternal characteristics of the studied population.

In the study group, of all 400 pregnancies, 163 (40.7%) CTG traces were reactive, and 237 (59.3%) were nonreactive. Late deceleration with reduced variability was present in 57.75% of nonreactive records whereas absent variability was observed in 28.75%.

Among the reactive CTG group, 142 (87.1%) had a normal vaginal delivery, 10 (6.13%) had assisted vaginal delivery and 11 (6.7%) underwent cesarean section whereas in the nonreactive group, 104 (43.9%) had a vaginal delivery and 132 (55.7%) had

Table 1. Maternal characteristics of the study population

	Frequency	Percentage
Age (years)		
<20	28	7%
21-25	144	36%
26-30	220	55%
31-35	8	2%
Parity		
primi	157	39%
multi	243	61%
Period of gestation		
Term	343	86%
Post term	57	14%
Risk factor		
PIH	127	32%
IHCP	93	23%
GDM	73	18%
Postdatism	57	14%
Oligohydramnios	15	4%
Polyhydramnios	9	2%
Rh negative	12	3%
Anaemia	13	3%
Prev LSCS	1	0.25%
Number of risk factors		
Single	343	86%
Multiple	57	14%

PIH-pregnancy induced hypertension, IHCP-intrahepatic cholestasis of pregnancy, GDM-gestational diabetes mellitus

Table 2. Parameters of perinatal outcome in accordance with CTG trace

CTG	CLEAR LIQUOR	MSL	APGAR@1 min	APGAR@5 min	NICU admission
Reactive (163)	145 (88%)	18(11%)	15(9%)	7(4%)	7(4%)
Suspicious (130)	84 (64.6%)	46(35.4%)	27(20.7%)	24(18.4%)	24(18.4%)
Pathological (107)	23 (21.4%)	84(78.5%)	66(61.6%)	53(49.5%)	53(49.5%)

Table 3. Predicting ability of pathological CTG for different parameters of perinatal outcome

	MSL	APGAR@1min	APGAR@5min	NICU admission
sensitivity	56.7	61.1	63	63
specificity	90.8	86	80.4	80.4
PPV	78.5	61.7	49.5	49.5
NPV	78.15	85.7	89.4	89.4

LSCS and 1 had instrumental delivery (p <.0001). The most common indication of cesarean section was non progress of labor in the reactive group and fetal distress in the non-reactive group.

In the reactive group, 18(11%) patients had meconium-stained liquor as compared to 46(35.4%), in the suspicious group and 84(78.5%) in the pathological group (p<.0001). Incidence of birth asphyxia as assessed by low APGAR @ 5 minutes was higher in the pathological group (49.5%) as compared to the reactive group (4.2%). NICU admission was also higher among babies from the pathological group (49.5%) as compared to the suspicious (18.4%) and reactive group (4.2%) (p<.0001) (Table 2).

The sensitivity and specificity of pathological CTG for NICU admission were 63% and 80.4% respectively (Table 3).

Discussion

The role of CTG in fetal monitoring is well documented and the correlation of pathological trace with the neonatal condition as evaluated by APGAR and HIE is well established. Although the vast majority of fetuses cope well during labor, the journey through the birth canal is stressful and the fetus may mount a stress-response. Thus, changes observed on the CTG trace reflect fetal response to the ongoing hypoxia during labor such as compression of the umbilical cord or reduction in the placental blood flow due to uterine contraction [5]. Continuous fetal monitoring is essential for the fetus, considered to be at risk of developing intrapartum hypoxic injury. It is a non-invasive, recordable method of fetal surveillance and is a logical solution to the human lapses of manual monitoring of fetal heart rate during labor.

A total of 400 cases were included in the study, the majority belonged to the 20-30years age group, 39% were primi and 61% were multigravida. The most common risk factor was PIH (32%) followed by IHCP and GDM. These data were comparable with studies by Mammen et al [6] and Khatum et al [7]. In the present study, the incidence of cesarean section was 55.69% in the nonreactive group compared to only 6.7% from the reactive group. This is comparable to the study by Rehman et al [8], where operative delivery was required in 2.3% of the reactive group and 60.8% of the non-reactive group. In this study, out of 400 cases, 163 (40.7%) had reactive CTG and 237(59.3%) had non-reactive CTG traces. In nonreactive trace, absent variability with late decelerations contributed maximum to abnormal outcomes (57.75%). Findings were comparable with a study done by Khatum al [7] who demonstrated that the fundamental component of the ominous FHR pattern is absent or decreased beat-to-beat variability.

Birth itself is a stressful situation and stress-mediated biochemical events may regulate the passage of meconium occurring in utero or after birth. In this study, out of 237 non-reactive CTG traces, 130 had meconium-stained liquor, in which 35% were from the suspicious group and 78% from the pathological group, whereas only 11% had MSL in the reactive group. This was statistically significant at p-value <.001. This supports the success of CTG in detecting fetal distress. Gupta et al [9] also reported similar results where 66.2% had MSL with non-reactive CTG. Similar findings were reported in Sandhu et al's [10] study, in which MSL was observed in 15% of reactive, 55% of suspicious, and 73% of pathological CTG traces in high-risk patients. CTG is a reliable tool to detect pre-existing fetal distress and those which appear during labor and was better

correlated in our study.

In this study, out of 237 non-reactive cases, 53 (49.5%) fetuses in the pathological group and 24 (18.4%) in the suspicious group had APGAR <7 at 5minute compared to 7 (4%) in the reactive group ($p < .05$), thus, the difference is statistically significant. This finding suggests that non-reactive CTG correlated well with low APGAR at 5 minutes. A similar observation was made by Gupta et al [9] where 36.5% of fetuses had APGAR <7 at 1 minute, and 60.8% had APGAR <7 at 5 minutes in the non-reactive group. However, in Atul K Sood et al's [11] study, only 5.8% of fetuses had APGAR <7 at 1 minute, and 5.2% had APGAR <7 at 5 minutes in the non-reactive CTG trace, which may be due to the difference in risk factors among the studied population. In Blessing David and Saraswathi et al's [12] study, 68.4% of fetuses had APGAR <7 at 5minute in the pathological group.

Neonatal admission was higher in the pathological group, since only 7 (4%) fetuses with reactive CTG and 24 (18.4%) fetuses from the suspicious group compared to 53 (49.5%) fetuses from the pathological CTG group were admitted in NICU, thus, the difference was statistically significant with p -value $< .05$. A similar result was seen in the study conducted by Kumar et al [13], where 44.5% of babies with non-reactive CTG and 6% of babies with reactive CTG were admitted to the nursery. Atul K Sood et al [11] in their study found that there was a significant correlation between APGAR <7 and neonatal admission and was more commonly associated with non-reactive tracing, as 11.2% of babies with non-reactive CTG were admitted in NICU. Similar rates of NICU admission were reported in the study by Saima U et al [14]: 51% in the non-reassuring CTG group compared to 18.4% in the reassuring group. Blessig David and Saraswathi et al [12] in their study found that 47.3% of fetuses in the ominous group had NICU stay. This suggests that CTG can detect fetal asphyxia in a significant number of cases as evidenced by low Apgar score and high NICU admission among the nonreactive group.

In our study, it is evident that CTG has a high sensitivity of 63% and specificity of 80.4 % with NPV of 90% in predicting perinatal outcome among high-risk patients. In a study conducted by Rehman et al [8] on 192 patients, a sensitivity of 60%, a specificity of 94.8% with PPV 57% and NPV of 90% for fetal distress were shown. Ingemarsson et al [5] and Qureshi et al [15] also reported a very high specificity in their studies. The high specificity of the test means that the normal test accurately excludes hypoxic fetal status at the time of testing.

Thus, with all parameters and conclusions, CTG is an important tool for intrapartum fetal surveillance and gives us immense satisfaction in timely saving the lives of many babies for which, an obstetrician strives and mother longs. However, the use of EFM is controversial. Many societies do not recommend continuous EFM in all pregnancies. Thacker et al [16] also suggested that the use of EFM has limited effectiveness and also carries an increased risk of interventions. The Cochrane review recommends limiting continuous EFM to high-risk pregnancies. In developing countries where antenatal care is inadequate, and a large number of high-risk pregnancies are being delivered in a crowded setting with a low patient-to-doctor ratio, CTG helps in early detection of fetal distress thereby facilitating timely

intervention to improve perinatal outcome.

Conclusion

In conclusion, the present study supports the role of CTG in high-risk obstetric patients. The test has high specificity and negative predictive value and appears to have a role in obstetric wards with a large number of high-risk cases and limited resources. It is simple, inexpensive, and simple to use and causes no inconvenience to the patient. Future researches are required to determine the supplemental diagnostic modalities which can enhance the positive predictive value of CTG.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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